

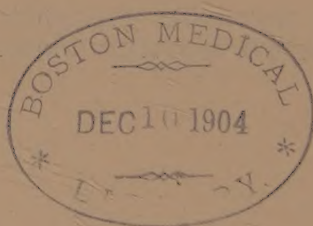
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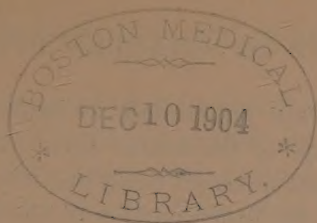
REPORT OF THE JOINT BOARD,
CONSISTING OF THE
METROPOLITAN PARK COMMISSION
AND THE
STATE BOARD OF HEALTH,
UPON THE
IMPROVEMENT OF CHARLES RIVER
FROM THE LINE BETWEEN WATERTOWN AND
WALTHAM TO MOTHER BROOK.

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REPORT OF THE JOINT BOARD UPON THE IMPROVEMENT OF CHARLES RIVER.

*To the Honorable the Senate and House of Representatives of the Commonwealth
in General Court assembled.*

The undersigned, members of the joint board, consisting of the Board of Metropolitan Park Commissioners and the State Board of Health, to whom was referred, by chapter 529 of the Acts of 1894, the investigation of the sanitary condition of Charles River and the preparation of plans for the improvement of the river and its banks from the line between Waltham and Watertown to Mother Brook in Dedham, and for the removal of any nuisances therefrom, respectfully submit the following report.

The two boards named in the act met for organization July 26, 1894. H. P. Walcott was elected chairman of the joint board, and H. S. Carruth secretary. Mr. Carruth resigned his position Jan. 1, 1896, and John Woodbury was chosen to succeed him. Messrs. Olmsted, Olmsted & Eliot were asked to consider the subject of the improvement of the river, and submit a report thereon. Mr. Eliot had been a member of the Charles River Improvement Commission, appointed under authority of chapter 390 of the Acts of 1891, and had subsequently been employed as consulting landscape architect in preparing the plans for the improvement of Charles River which were recommended by the joint board appointed to consider the same, and a report upon which was presented to the Legislature in April, 1894.

The condition of the river has been personally ascertained by members of the board at various times, and they have carefully considered the reports made to them by the experts employed, and have reached the following conclusions.

The position of the Charles River in its relation to the metropolitan district has, necessarily, a very great influence upon the health and comfort of the people living in its vicinity. So long as

the stream was comparatively unpolluted, its banks were occupied at eligible sites by dwellings of the better sort. The increase of pollution and the consequent nuisance occasioned by it have driven from the banks throughout the lower portion of the river those who could afford to establish new homes in more attractive places, and the houses once occupied by these people have been taken by a poorer population, or by manufactories that seek the stream for commercial advantages or to be at a distance from neighbors likely to complain of offensive processes incident to the business there carried on. In concluding their report, the joint board of 1894 made this statement: "Your board feels that no treatment of the Charles River can be entirely satisfactory which does not regard the condition of the river above and in Waltham. At the boundary of that city, by the terms of the act under which we are directed to make our investigation and report, our labors end."

It will be remembered that the plan submitted by the commission of 1894 called for the preservation of the public reservation along the banks of the river up to the line between the city of Waltham and the town of Watertown. At certain points this public reservation is bounded by existing streets; at certain other points new streets would have to be constructed, for the purpose of limiting the amount of land to be taken to the smallest area necessary to procure a satisfactory reservation. It is understood that the appropriation subsequently made by the Legislature of that year for the purpose of enabling the Metropolitan Park Commission to take such land was not sufficient to carry out the entire plan as recommended.

One of the disagreeable incidents of the failure to complete this plan is shown by the use of a portion of the low land near the river in Waltham for the erection of a manufacturing establishment, which is likely to be an injury to the appearance of the banks and the comfort of residents in the vicinity; and we take this occasion to again call attention to the necessity of securing the banks of the stream below the Waltham line and above the centre of Watertown from still further encroachment.

It must not be understood, from the language just used, that we wish to banish from the banks of the stream all manufacturing establishments. We recognize the necessity to many of them of the location which they now occupy; but it is also true that

there are located here some manufacturing establishments which almost of necessity involve a greater or less injury to the district in which they are placed, and it does not seem to us reasonable that the centre of one of the most attractive portions of the metropolitan area should be forever given up to uses for which many less attractive spots are equally available.

The first thing likely to impress a person looking at a map of the district above the dam of the Boston Manufacturing Company at Waltham is the large area occupied by the water surface of the river above that point. On any pleasant day of the warmer season of the year this surface is a resort for boats of every description, used for the purposes of innocent and healthful enjoyment, not only by the people of the neighboring towns but by visitors from the whole metropolitan district, and, if nothing else could be done, it would be the part of wisdom to take for public uses this area, at least. Almost the only circumstance which at present seriously impairs the attractiveness or the healthfulness of this water surface and the banks bordering it is the use made of the water by the manufacturing establishments which control the principal dam. Whenever the water is drawn several feet below the level of the top of the dam, as it occasionally is in the seasons of protracted drought, the muddy banks or shores are exposed. As the stream for a large part of its course is still the public sewer of the district, much putrescible animal and vegetable matter is deposited upon these exposed banks and soon enters into decomposition, becoming a source of discomfort and positive injury even to the health of those who visit the stream for purposes of recreation or who live upon its banks.

To take such control of the stream as would prevent material changes in the level above this dam would probably inflict at most only a slight damage upon this manufacturing industry. It is a damage, however, that can readily be estimated and easily paid for. The limit which we should recommend to be placed upon the water of the river at this point and at all points where dams exist is that the establishments should be restrained in their use of the water of the river to the actual capacity of the river. That is to say, a diurnal variation of the surface of the water of the river is unavoidable, and does not appear to us to be the source of danger; but the river should at no time be so far drawn upon during the hours of

use of the water that the volume of water thus used could not be replaced by the accumulation through the portion of the day when the water is not used.

If it were possible to actually take possession of a strip of land on both banks of the river above the more closely built up portions of the city of Waltham, we believe, having regard to a long future, that it would be a wise investment; and we advise that some portions of the banks of the river should now be taken, either because they are so attractive in themselves that the loss of their attractiveness would be a serious injury to the appearance of the district, or because they are so unattractive that they are necessarily of small value, and likely to be occupied by objectionable establishments and residences.

In few districts in the metropolitan area have the residents themselves shown a more unselfish interest in the development of their local public grounds than along the banks of this stream, and the river is used as a place of healthful recreation by crowds drawn from beyond the limits of the towns that border upon the stream.

With that inevitable growth of population that is sure to come, the importance of this territory lying in the heart of the metropolitan district must year by year grow, and the difficulties of obtaining a public ownership just as rapidly increase.

Aside from the æsthetic and recreative interest which the beautiful shores of this river possess, and paramount to it, is the question of their healthfulness; and in this relation no disease has in recent years attracted more attention, or deserved more, than intermittent fever, or the disease due to the so-called malarial influences. The real importance of this disease cannot be measured by the deaths which are recorded as due to it. The disabling effects of it cling to the unfortunate subject for years, destroy the capacity for work and diminish the enjoyment of life. Communities which have long suffered from the disease would consider no expenditure of money extravagant which would free them from it; and portions of this district have already suffered enough in recent years to realize how grievous the hardships inflicted by a perhaps unnecessary malady are.

Amid all the uncertainties that surround the origin of the disease, the experience of mankind is united upon this, that variations in the water level of a stream or pond create conditions favorable

to the spread of malaria. Nowhere in the district about Boston are these conditions of a variable water level, at the season of the year when the malarial influences are most active, more marked than above the dam at Waltham. The large amount of organic matter necessarily present in the stream undoubtedly contributes something to the danger. So long as the banks are covered by water the processes of decomposition go on slowly, but on the exposed shores sun and air hasten on these processes of decay, with results which the people have always instinctively and justly feared.

These considerations emphasize the desirability, from the sanitary point of view, of maintaining the river's surface at a level as nearly uniform as possible, and in this matter the interests of public health and popular recreation concur.

In November, 1894, the State Board of Health issued a circular, which was addressed to physicians living in the cities and towns bordering upon the Charles River from Watertown to Dedham, for the purpose of obtaining information in answer to the following questions : —

1. When did intermittent fever first appear in your town, judging from your own observations?
2. Has it been more or less prevalent in your town during the past five years than previously?
3. Have any means been taken for its prevention, such as the drainage of wet lands, or other methods of improvement?

Fifty-seven physicians replied to these circulars, many of them very fully. The compilation of the replies was intrusted to Dr. J. J. Thomas, who also visited personally all of the infected districts. Replies were received from West Roxbury, Jamaica Plain, Brookline, Dedham, Dover, Needham, Waltham, Wellesley and Weston.

The occurrence of a few scattered cases in these towns from 1875 to 1885 “ points to the presence of infected foci which, under favorable conditions, have become starting-points for its spread in the infected region.”

IMPROVEMENT OF CHARLES RIVER.

The following summary gives the results of the replies to the second question, relative to its comparative prevalence in the five years (1890-94):—

Total Reported Cases, by Years.

YEARS.	Cases.
1890,	442
1891,	659
1892,	1,355
1893,	1,291
1894,	1,236
Total,	4,983

Prevalence, by Towns (1890-94).

CITIES AND TOWNS.	Cases reported.	Population (1890).	Ratio per 1,000 of Population.
Brookline,	45	12,103	3.96
Dedham,	12	7,123	1.68
Dover,	—	727	—
Needham,	62	3,035	20.40
Newton,	4,266	24,379	175.00
Waltham,	434	18,707	23.10
Wellesley,	58	3,600	16.10
Weston,	100	1,664	60.10

Nearly ninety per cent. of the reported cases occurred during the months of May, June, July, August, September and October.

In regard to the condition of the land near the river, Dr. Thomas says: "Both along the river itself and beside the various tributary streams is found much swampy and poorly drained ground. Not only is this true, but in many places the river itself spreads out over

a considerable area, forming extensive shallows surrounded by a wider or narrower strip of marsh. At seasons when the water is low, many of the shallows are exposed, or partly exposed, to the air and sun, while retaining abundance of moisture; in other words, forming most favorable culture grounds for the malarial parasite. This exposure of large areas of surface, when the level of the water is lowered but a few inches, is seen not only in the bed of the Charles River but along many of its tributaries and in many of the ponds which lie scattered through the whole region, and even more in the case of artificial reservoirs constructed for manufacturing purposes, or for supplying water to neighboring towns and cities."

Two methods occur to us by which the preservation of the attractive features of the stream may be secured; one by actual purchase of so much of the river banks as may be necessary for this purpose, the other by some arrangement with the riparian owners, by means of which the banks of the river, to an appropriate distance from the stream, shall be controlled in such manner as not to interfere with full private enjoyment of them, but at the same time to prevent, from the public point of view, a harmful use of them.

Some of the higher banks of the stream are now in the hands of individuals who have built expensive houses and laid out ornamental grounds; for the present, at least, the interests of these owners are the same as those of the public,—the preservation of the river with all its attractive features. To them, therefore, the proposition to establish a line along the banks of the stream within which no changes shall be made without the consent of some public authority acting in the interests of all would be a benefit rather than a hardship, for they would be protected against injurious changes upon neighboring estates. It would not be advisable, in our opinion, to allow the public any right to enter upon the territory thus reserved, for there should at the same time be secured at convenient and attractive points sufficient areas for all the reasonable uses to which this river is now put,—uses which would be indefinitely multiplied in case the natural beauties of this district are maintained.

Estimates which have been made by persons in whose knowledge of the territory in question we have full confidence show that sufficient land might be acquired by purchase, where actual public ownership seems essential, and control of certain other high-priced or developed lands secured, the possession of which by the public

is not requisite unless an inferior use of them is feared, for a sum of money not exceeding \$300,000. In this sum are included the probable expenses of building some simple contrivances for the easy transfer of boats over the successive dams upon the stream.

To obtain the various results, the necessity of which has been thus briefly stated, it is, in our opinion, imperative that the following steps should be taken:—

1. That the high-water surface of the Charles River, from the dam at Watertown up to the Dedham line, should be made a portion of the metropolitan park system; that measures should be taken for securing a water level as nearly permanent as possible throughout the warmer months of the year; that arrangements should be made for the convenient transfer of boats over the dams on the river.

2. That certain lands be taken upon the banks of the river for places of public resort and convenience, and that rights be taken in all the remaining frontage on the river for the purpose of preventing obnoxious uses of the same.

3. That the whole area so secured be placed under the control of some public authority having power to protect and improve it.

HENRY P. WALCOTT, *Chairman*,
PHILIP A. CHASE,
WILLIAM B. DE LAS CASAS,
ABRAHAM L. RICHARDS,
AUGUSTUS HEMENWAY,
EDWIN B. HASKELL,

Board of Metropolitan Park Commissioners.

HIRAM F. MILLS,
FRANK W. DRAPER,
GERARD C. TOBEY,
JAMES W. HULL,
CHARLES H. PORTER,
JULIAN A. MEAD,

State Board of Health.

REPORT OF THE LANDSCAPE ARCHITECTS.

Dr. H. P. WALCOTT, *Chairman*.

Chairman of the Joint Commission on the Improvement of Charles River.

SIR: — In accordance with your request, we have examined sixteen miles of Charles River and its banks, between the head of the tide in Watertown and Mother Brook in Dedham, and beg leave to report as follows: —

The Charles is a typical example of a class of rivers which, having been forced out of their original channels by the stony rubbish of the ice age, now find their way through the hollows of the billowy surface of this rubbish as best they can. In its meandering course among the hills and dales of glacial stuff, Charles River simply fills each hollow of the land until it overflows into the next. Many of these bowls are broad and shallow, and have been gradually filled by level deposits forming reedy swamps like those between West Roxbury and Dedham. Others of the hollows are small and steep-sided, like the so-called “kettle-holes,” which are so frequent on the adjacent dry land. The waters move onward by overflowing the lowest place in each hollow’s rim. Thus, if the rim between the Dedham valley and the valley of Mother Brook were a trifle lower, the Charles would flow down to join Neponset River, and its present course down to Watertown would be occupied by a mere brook.

The scenery of the stretch of river which is here under consideration is pleasantly interesting without being very striking. Steep gravel bluffs and ridges characteristic of “drift” surfaces generally frame the river landscape or rise as islands in the swamps. Sometimes close at hand and sometimes distant, these framing banks not infrequently rise steeply to a height of fifty or sixty feet above the water. All the bluffs were originally forested and many are still clothed with woods; the gentler slopes, however, have long since been cleared, cultivated or built upon. The level swamps which

(above Upper Falls) intervene between the stream and the dry land retain their primitive clothing of rushes and sedges, and, with the distant and receding slopes of bounding uplands, present specially broad and pleasing landscapes. Strikingly contrasting scenery is found at the Upper and Lower Falls, where the river chances to flow over and between ledges of solid rock.

In the early years of the Massachusetts Colony Charles River served as a principal highway of the country, as, indeed, it had served for the Red Men. The village of Watertown was founded very early at an important point on this highway, namely, "the head of the tide." "Lumbering" was long an important industry. Saw mills, and afterwards grist mills, took advantage of the water power furnished by the river's tributary brooks. On the other hand, it was not until after the river had ceased to be useful as a highway for the conveyance of merchandise and lumber that dams were built in the main stream itself. These dams, now eight in number, were originally constructed in accordance with the terms of an act of the General Court, by which it was sought to encourage manufacturing. With this purpose in view, the Commonwealth practically made a present to the manufacturers of so much of the common property in the rivers and lakes of the State as they required for the establishing of manufacturing by water power. The dams so authorized were naturally built where the greatest "fall" was to be had, and thus at almost every fall or rapid in Charles River there is found one or more factories, with the accompanying collection of dwellings. The dams have considerably increased the ponding effect of the purely natural dams or "rims" above mentioned, until the present river has virtually become a chain of narrow and quiet ponds, bordered by the swamps, fields or steep banks above described, and separated one from the other either by dams or by short reaches of naturally swift water.

Of the several villages which have gathered about the mill-dams, Waltham in particular has grown to be a considerable city. It is not, however, the growth of any of the mill-towns which has brought Charles River to the attention of the Legislature; it is rather the remarkable increase in the population of Boston and its suburbs, which has created the demand for a reconsideration of the state of the river, as well as for its regulation with a view to meeting the new desires of this population. In spite of the already

considerable defacement of its banks and the inconvenience occasioned by the mill-dams, the river has come to be again used as a highway,—a purely pleasure highway now, instead of the traffic way it once was. The many who enjoy this boating on the river are naturally anxious to see the passage of the dams made easier and the beauty of the scenery preserved, if possible. As Boston grows, the inhabitants of the metropolitan district will more and more need and demand agreeable means of recreation. No pastime is more agreeable than boating. Nowhere else so near Boston is there any such a pleasant boating course as Charles River. The preservation and regulation of this boating course might thus very properly become a matter for co-operative or “metropolitan” regulation.

Holding this view, we have deemed it to be our present duty to study and point out what must be done in order to make and keep the navigation of the Charles by small boats both convenient and agreeable. When this has been plainly set forth, it will remain for the metropolitan district to determine whether to attempt the necessary works or not; what steps, if any, to take first; and what governing authority to place in charge of the undertaking.

If the river is to be preserved as a pleasure highway or parkway, the mills and factories must, in the first place, be induced or compelled to cease pouring their objectionable wastes into the current. Sewage, strictly so called, can henceforth be diverted from the stream by the metropolitan intercepting sewers. The mills, as well as most dwellings near the river, are now presumably connected with the sewers. Nevertheless, it is still found convenient to pour the wastes and the washing waters from starch factories, silk mills, dye houses and the like into the stream. These obnoxious liquids are much diluted, and, though they frequently offend the eye, they seldom give off odors so long as they are moving with the current. When the scum of such stuff collects in a shallow cove or among the grasses of a swamp and the water level then happens to fall, it is obvious, on the other hand, that an unpleasant condition is produced. A first duty of any authority placed in charge of Charles River should be the better regulation of the discharge of waste matter into the stream.

A second and analogous duty of any such governing authority

ought to be the limiting of the raising or lowering of the water levels by the owners of dams. While population on the banks of the river was sparse, the flooding of low lands by back-waters at one season and the complete drawing off of these back-waters at another season was perhaps allowable; but now that the streets and houses of the suburbs are, in places, pressing close to the river, the practice is no longer expedient. While the water is high, vegetation grows rankly in the shallows, only to rot in the hot sun when the water is drawn off. The practice also injures the appearance of the river banks; and now that the various factories depend comparatively little upon the water power, and value the water of the river chiefly for washing purposes, there ought to be little difficulty in formulating agreements defining the allowable raising or lowering of the mill-ponds.

There remains still a third problem to be solved by the suggested public authority in conjunction with the owners of dams. Rights of way over or around the dams will need to be acquired for men and boats, and in some cases similar rights in private waters, leading to or away from dams. Such public passageways for boats and canoes will, in most cases, inconvenience the mill owners very little; while the necessary fences, runways and other constructions need cost the public no great sum. At present most of the pleasure boating takes place between Lower Falls and Waltham and between Upper Falls and Dedham, the five intervening dams discouraging all but the bolder canoemen. The elevations above sea-level of the tops of these dams, as well as the dams further down stream, may be recorded here as follows:—

	Feet.
Dam No. 1, Watertown,	16.00
Dam No. 2, Bemis,	21.50
Dam No. 3, Waltham,	39.95
Dam No. 4, Lower Falls,	48.32
Dam No. 5, Lower Falls,	53.94
Dam No. 6, Lower Falls,	63.95
Dam No. 7, Upper Falls,	75.67
Dam No. 8, Upper Falls,	90.01

These figures indicate the normal elevation above sea-level of the surface of the ponded waters behind the dams; but it should be noted that the pond behind dam No. 3 does not reach up to dam No. 4, and that the pond behind dam No. 8 extends only to a rapid

near the New England Railroad bridge, where the stream overflows the natural dam which ponds the Dedham swamps. The city of Newton recently expended a small appropriation in removing boulders from a rapid just below Lower Falls, for the sake of improving the navigation. The cost of similar improvements in other swift waters would be moderate in proportion to the benefit accruing.

Assuming, for the moment, that the metropolitan public will desire to check or regulate pollution and the drawing down of the mill-ponds, as well as to facilitate the passage of the dams and rapids, the next step in the development of the river as a pleasure highway will be the acquisition of a greater number of public landing places. It will be easy to provide landing stages at the existing public bridges, and there are fifteen such bridges between the Watertown dam and Dedham. Public landings can also be obtained, if necessary, at the eight or nine other places at which highways now touch the river bank. Sites for any additional desirable landings might well be provided by the local authorities governing the laying out of streets in the river towns and cities. As new streets are constructed, some might be extended to the river's edge, where connection would thus be made between the ordinary land highways controlled by local governments and the through water highway governed by a joint commission. The commission in charge of the river would naturally provide and maintain the necessary floating stages, together with all other desirable aids to navigation. The public floats would be marked by such flags and lights as would distinguish them from private landings. There seems to be no difficulty in thus dividing the domains of the local and the general authorities.

Beside the numerous boats and canoes owned by riverside land owners, the stream is used by many other boats belonging to members of the boat clubs which have houses at Waltham, Riverside, West Roxbury and Dedham. Still other boats are leased for the hour or day by professional boatmen, who maintain attractive landings and boat houses at Riverside and elsewhere. Should the river be improved as a pleasure-boating course, the number of boats kept for private use and for hire would undoubtedly increase, and the commission in charge would soon need to establish a service of police. Such a service might be created for this water

parkway as readily as for the so-called metropolitan parkways lately ordered by the General Court and governed by the Metropolitan Park Commission. In addition to watching the river, the police would serve to preserve the adjoining private grounds from trespassing. The force would, however, be chiefly useful as guides and guardians of the boating public, and it would accordingly seem equitable if a part of the expense of maintaining the service should be borne by the owners of boats, from whom an annual license fee might be collected, as is done by the Thames Conservancy Board in England. Electric launches might be similarly licensed by the governing commission, to run as omnibus boats or as cabs.

If the various suggestions thus far offered can be carried out, the river will become conveniently and safely navigable by small boats. It may, however, be pertinently asked, What is the use of improving the navigation, if the present charm of the river scenery is to be gradually destroyed?

It has been well said that "the life of a river, like that of a human being, consists in the union of soul and body, — the water and the banks. They belong together. They act and react upon each other" ("Little Rivers," by Henry Van Dyke, 1895). Accordingly, it is distressing to note how the banks of Charles River have been here and there defaced within the last few years, while there appears to be every likelihood that the same processes will work additional injury as time goes on. The tendency towards the destruction of the beauty of small rivers flowing through crowded neighborhoods is everywhere as noticeable as it appears to be inevitable. This destruction, as a matter of fact, has been successfully averted in but a very few instances. It is, indeed, quite imaginable that it may be unwise to attempt the preservation of landscape in many cases. Much natural beauty is, doubtless, rightly sacrificed for the furtherance of various important human ends. It seems, then, advisable, in the first place, to consider what must be done to effectively preserve at least a sufficient part of the loveliness of the landscape of the Charles, and then to leave it to the metropolitan community to determine whether the game is worth the candle; or in other words, whether the preservation of the scenery is likely to be worth to the community the probable first cost, plus the recurring cost of supervision.

The briefest study of the circumstances leads irresistibly to the conclusion that the ownership of the river banks by numerous private persons tends slowly but surely to the fatal injury of the scenery. It is true that many sections of the river bank are at present occupied as country seats by citizens who take pride in the beauty of the shores. On the other hand, there are other owners whose only thought is to sell their land in suburban lots as soon as may be; and these, in their zeal for every possible dollar, encourage building down to the very water's edge. Even wet lands near the river are now advertised as house lots; and when some of these shall have been occupied as shabbily as is usual, the adjacent country seats will lose much of their charm, and will in turn be subdivided and sold in small parcels. These are some of the processes which are working the destruction of the seclusion and beauty of the river scenery.

Assuming, as we do, that no one would propose to oust any of the more considerable of the river-side industries, it may be noted that there seem to be but two ways of dealing with the remaining private river banks, if the scenery is to be even measurably preserved. In connection with land parkways, a "building limit" more or less distant from the edge of the parkway is commonly agreed upon. If Charles River is made a water parkway, governed by a park commission, it may be possible to secure such a "building limit" on the banks in many places, together with a further "restriction" preventing private owners from felling trees between the water and the "building line" without permission. The restricted strip would, of course, need to be wider than is usual on land parkways. Private boathouses and landings might be allowed within the building limits under special permits. The general public would acquire no right to land, or to go and come, upon shores thus restricted. If, however, the governing commission could be endowed with power to secure such restrictions, it would seem that much of the local scenery of the shores might be preserved, without depriving the owners of country seats of either their privacy or their dearly bought privilege of personally possessing a bit of river bank. The public would, through the proposed action, certainly acquire large present and prospective benefits not now enjoyed.

The other and the more thorough-going way of accomplishing the desired end would consist in the acquirement by the governing

commission, through gift, purchase or condemnation, of the actual fee and possession of the now private river banks. This proposal is put forward last, because it plainly calls for several times the expenditure, both at first and annually, that all the preceding suggestions put together would require. The carrying out of the preceding suggestions would make Charles River simply a *park-way*, bordered by partially "restricted" private lands. This last suggestion would make the river and its scenery the central feature of a *park*, the banks and the waters being alike usable by the public. As with all parks, the boundaries, in this latter event, ought, properly, to be streets providing frontages for houses built facing the public domain. The spaces of varying width between these boundary streets and the water would, in most places, need to be made accessible by footpaths; while driveways might eventually be constructed as branches of the boundary roads leading to some of the more remarkable points of view. Lastly, the lands, as well as the waters, thus controlled by the governing commission, would need to be continually policed.

It cannot be doubted that the possession of this river bank, in addition to the possession of the river itself, would greatly increase the possible enjoyment of the people of the metropolitan district. To follow on foot the meandering shore of a pretty stream is almost as delightful a pastime as floating with the current. It is also pleasant to be able to land and perhaps picnic anywhere from one's boat. On the other hand, if all the people of Boston and the other remoter parts of the metropolitan district, who might visit the parked shores of the Charles in carriages or on foot, were to be counted, it is not likely that they would number more than a small fraction of the sum of those who would come from considerable distances in order to take part in boating. In other words, it seems questionable whether the acquisition of public ownership on these particular shores ought not to be a local, rather than a metropolitan undertaking. The river-bank is doubtless the most advantageous site for the public recreation grounds of all the river-side communities. A given appropriation will buy more pleasant and refreshing scenery on the river banks than anywhere else. River-bank parks will enhance the values of adjacent building lands so considerably that many land owners may well afford to encourage park-making by offering land for nothing or for very low prices.

It is, however, no part of our professional function to debate

either this question of metropolitan *versus* local public ownership, or the broader question as to whether public ownership of any kind is really desirable.

Many of the present facts, upon which the decision of these questions must largely rest, are illustrated by the new and accurate map of the river, made for the joint commission, and submitted, at a reduced scale, herewith. From this map the following statistics of the present public and semi-public frontages on the river bank have been obtained by scaled measurements.

	I.	II.	III.	IV.	V.	VI.
	Total Frontages.	Frontage Closely Built.	Frontages of Public Water Reservoirs.	Frontage of Semi-Public Institutions.	Frontages of Public Parks.	Frontages not Closely Built and still belonging to Private Individuals.*
Watertown (above dam),	9,250	500	-	-	-	5,700
Public Landing,	-	-	-	-	750	-
Water Company,	-	-	-	2,300	-	-
Waltham,	31,500	17,200	-	-	-	11,800
Mt. Peake Cemetery,	-	-	-	800	-	-
Waltham Water Reserve, . . .	-	-	1,700	-	-	-
Weston,	13,500	-	-	-	-	10,600
River Park,	-	-	-	-	850	-
Norumbega,	-	-	-	450	-	-
Boston Athletic Association, .	-	-	-	1,600	-	-
Newton,	57,950	3,250	-	-	-	37,270
Auburndale Park,	-	-	-	-	500	-
Lower Falls Park,	-	-	-	-	4,500	-
Cheese Cake Brook Outlet, . .	-	-	-	-	130	-
Hemlock Gorge Reservation (part of),	-	-	-	-	1,100	-
Newton Water Works Pumping Station,	-	-	1,200	-	-	-
Newton Water Reserve (part of),	-	-	9,000	-	-	-
Roman Catholic Working Boys' Home,	-	-	-	1,000	-	-
Wellesley,	14,800	2,200	-	-	-	11,800
Hemlock Gorge Reservation (part of),	-	-	-	-	450	-
Wellesley Water Works, . . .	-	-	350	-	-	-
Needham,	20,500	-	-	-	-	4,300
Hemlock Gorge Reservation (part of),	-	-	-	-	1,200	-
Newton Water Reserve (part of),	-	-	15,000	-	-	-
Dedham (to Mother Brook), . .	16,900	-	-	-	-	13,650
Brookline Water Reserve (part of),	-	-	3,250	-	-	-
Boston (West Roxbury),	10,250	-	-	-	-	2,000
Brookline Water Reserve (part of),	-	-	4,800	-	-	-
Boston Truant School,	-	-	-	1,250	-	-
Boston Caledonian Club, . . .	-	-	-	2,200	-	-
	174,650 ft.	23,150 ft.	35,300 ft.	9,600 ft.	9,480 ft.	97,120 ft.
	33.05 M.	4.38 M.	6.68 M.	1.81 M.	1.79 M.	18.39 M.

* Being the remainder obtained by subtracting from the figures of column I. the sum of the figures of columns II., III., IV. and V.

It appears from these statistics that the cities of Waltham and Newton and towns of Watertown and Weston already own public grounds situated at the river's edge. It also appears that the frontages held for the protection of water supplies are both many and long (see column III.), and that, after subtracting the banks occupied by established industries, more than one-third of the total remaining frontage on the river is already preserved from spoliation by either public or semi-public ownership. The frontage remaining after subtracting the industrial frontage (column II.) from the total frontage (column I.) is 28.67 miles, of which 10.28 miles (the sum of the totals of columns III., IV. and V.) are already protected. If the remaining frontage of 18.39 miles can be "restricted" and the river made a water parkway, additional parks may be strung along the connecting chain, as private generosity, local public spirit or "metropolitan" appropriations may determine in the future.

Respectfully submitted,

OLMSTED, OLMSTED & ELIOT.

BROOKLINE, MASS., Dec. 9, 1895.

INTERMITTENT FEVER IN THE CHARLES RIVER VALLEY.

The history of intermittent fever in Massachusetts has already received careful and able treatment by various writers. The paper of Dr. O. W. Holmes¹ in 1836 is the first careful examination of the facts which we possess. In 1881 there appeared the paper of Dr. Adams² of Pittsfield, which took up the history of the reappearance of intermittent fever in Massachusetts in 1877 and the following years, during which the disease existed to a considerable extent in the Connecticut valley and in Berkshire County. At the time of the investigation, in July and August, 1880, it was reported that there were no cases of the disease in Suffolk and Norfolk counties; in Essex County one case of remittent fever was reported from Amesbury; while in Middlesex County scattered cases of intermittent fever were reported from Ayer, Wakefield, Woburn and Billerica. Although no cases were reported from Watertown, Dr. Adams quotes³ Dr. A. Hosmer as follows:—

“I have heard long since, in a vague, traditional way, that many years ago intermittent fever was original in Watertown. I have never found any means of testing the truth of the statement. Of course, now and then I see a case of malarial disease; but with a single exception, soon to be stated, it is all imported. Twenty-five years ago a case of intermittent fever occurred in the practice of my uncle, the late Dr. Hiram Hosmer. The patient was a man who had never been out of the State, and who lived on the shore of Fresh Pond. The disease was regarded as the product of the place, and

¹ O. W. Holmes, M.D. Facts and traditions respecting the existence of indigenous intermittent fever in New England. Boylston prize essay, 1836. Boston, 1838.

² J. F. A. Adams, M.D. Intermittent fever in Massachusetts. Second annual report of the State Board of Health, Lunacy and Charity of Massachusetts, supplement, p. 47f. Boston, 1881.

³ Loc. cit., p. 92.

the case was considered unique. It is a curious fact, that an attack came just as the patient was getting ready to move to the West."

Dr. Holmes mentions a case reported to him by Dr. James Jackson, occurring in Boston, which he had seen "a number of years since."

Thus we see that up to 1880 intermittent fever was practically unknown in the eastern part of Massachusetts, except for the statement in Mann's Medical Sketches, published in Dedham in 1816, and quoted by Dr. Holmes, that "intermittent fevers one hundred years ago were common in the lower towns of Massachusetts." Dr. Holmes, however, was unable to confirm this statement.

In 1886 appeared the paper of Dr. Z. B. Adams¹ of Framingham. In this paper Dr. Adams mentions the fact that Dr. Holmes found that intermittent fever probably existed at Providence, R. I., and at Hopkinton, Mass., and speaks as follows: "The disease in the last-named locality appears to have been indigenous in the neighborhood of two ponds, situated in the westerly and south-westerly portion of that town. One of these, called North Pond, empties into the Blackstone River, which debouches at Providence, R. I.; while the other, Whitehall Pond, forms one of the largest sources of the Sudbury River, which flows through the town of Framingham."

The first case of intermittent fever in the neighborhood of Framingham which Dr. Adams could find was one occurring upon the borders of the Sudbury River, in 1876, at a point about half-way between the villages of Framingham Centre and Saxonville. No more cases were known to have occurred until after the dams were erected by the city of Boston on the Sudbury River and Stony Brook. In a house on the shores of Basin 3, on Stony Brook, "malarial symptoms have appeared at various times since 1880,"² Dr. Adams tells us. Another case was reported, of apparently indigenous origin, upon the Natick road, two miles east of South Framingham, in 1883. In June, 1885, occurred the first case of the epidemic in South Framingham, in which over two hundred cases are known to have occurred up to Oct. 1, 1885. The greater number of these cases appeared during the month of Au-

¹ Z. B. Adams, M.D. Malaria in Eastern Massachusetts. Seventh annual report of the State Board of Health, Lunacy and Charity of Massachusetts. Supplement. Boston, 1886.

² Adams, loc. cit., p. 8.

gust, and the number fell off markedly about the middle of September. The area of the town near the Boston & Albany Railroad, covering about two hundred acres, one-half at least of which, says Dr. Adams, is bog and swamp, contained seventy-two houses; in fifty-one of these malaria is known to have occurred. In March of the next year the disease began to show itself among those attacked during the preceding summer, and new cases were seen. The attacks of the disease have occurred to a greater or less extent each year up to the present time.

In 1890 there appeared Dr. Cook's paper upon intermittent fever.¹ From this paper we learn the following facts about the progress of intermittent fever in the Charles River valley. Boston and Brookline report only sporadic cases, while we find the disease already at this time more or less epidemic, or, more properly speaking, endemic, in Cambridge, Dedham, Dover, Hyde Park, Needham, Newton, Waltham, Watertown, Wellesley and Weston, as well as at Framingham, where, as we have already seen, it appeared in epidemic form in 1885. In regard to the time when the disease first made its appearance in the towns mentioned, we find that Watertown reports it as epidemic as early as 1884, Hyde Park, Needham and Weston give 1885, the same year that the epidemic in Framingham appeared, while Boston reports sporadic cases in 1885. Cambridge, Newton, Waltham and Wellesley regarded it as epidemic in 1887, and Dedham in 1888. Brookline reported sporadic cases in 1889, and Dover reported the disease as epidemic, without giving the date of its appearance.

Taking up these towns and cities more in detail, we learn that Dr. Cook found only sporadic cases in Boston. From the Allston district five cases were reported in 1889, all near the Charles River. In the Brighton district the disease is reported to have first appeared in 1887. In Brookline cases were first seen in June, 1889. In Cambridge scattered indigenous cases were observed by Dr. Hildreth about 1880, upon the borders of Fresh Pond, but cases were not seen in any number till 1887, and in 1889 it became really epidemic in this city. Most of the cases occurred near Fresh Pond and Alewife Brook, or at Parry Brothers' brick yards. In Dedham intermittent fever was first observed in 1888, when it was quite

¹ Dr. C. H. Cook. Intermittent fever in Massachusetts. Twenty-first annual report of the State Board of Health of Massachusetts. Boston, 1890.

prevalent along the Charles River. In regard to Dover, Dr. Cook says that physicians living in adjoining towns mention cases there, but give no details. From Hyde Park it was reported that the first cases were seen about 1885, and that since that time there had been a large number of cases. From Needham Dr. A. D. Kingsbury reported "indigenous cases first in 1885, — since then many cases." During 1889 he says that he treated from twenty-five to thirty cases. From Newton Dr. H. M. Field reported that he had seen an indigenous case as early as 1877, but the disease could first be called epidemic in extent about 1887, since which date it had prevailed in most, if not all, of the wards of the city. Dr. Porter of Auburndale reported that when first observed it was among the Italian laborers in Weston at the Cambridge Reservoir, and that it appeared soon after at Islington and Riverside, both on the Charles. Later it appeared in nearly all sections of Auburndale, West Newton, and other wards of the city. Dr. W. O. Hunt of Newtonville reported many cases near swampy lands, and a number where new roads were being constructed. Dr. Stone of Newton Corner had heard of cases "near a pond." Dr. F. W. Webber, also of Newton Corner, reported that "most cases were along the borders of the river, or in the immediate vicinity of some swamp." Dr. J. F. Frisbie reported cases near swamps and ponds. Dr. J. R. Deane of Newton Highlands reported the disease "near upturned soil." Dr. W. H. Hildreth of Newton Upper Falls reported cases as "generally near the Charles River." Over two hundred cases from Newton were reported from the outbreak of the disease, up to the time the reports were made in 1889. In Waltham Dr. Alfred Worcester reported its first appearance as in August, 1887. The number of cases in this city up to the fall of 1889 was reported to be about one hundred. During the few years preceding, many new streets had been built and cellars dug. Old streets had been dug up for the purpose of laying water, drain and gas pipes. In the summer of 1886, in the preparation for the construction, on Stony Brook, of the reservoir for the Cambridge water works, a mill-pond, previously full for many years, was drawn down, the mud from its bottom scraped out, and thousands of loads piled on the land near by. In this immediate vicinity probably every person, old and young, had intermittent fever, we are told. The disease seemed to follow the deep trench in which the water main was car-

ried to Cambridge. It also prevailed in the vicinity of the Charles River and the adjoining low lands. In Watertown Dr. J. A. Mead reported the date of its first appearance as 1884, and stated that, while many cases occurred in 1884, 1885 and 1886, in 1889 fewer were seen. In Wellesley intermittent fever first appeared in 1887, most of the cases being along the course of a brook and its contiguous low land. The first indigenous case reported from Wellesley Hills occurred in September, 1888. From Weston the date of its appearance was given as August, 1885. During the excavation and construction of the dam for the Cambridge water works, begun in 1885 and finished in 1888, almost the entire working force was afflicted at different times.

Thus we see that intermittent fever, while more or less known in Massachusetts for many years, has only made its appearance, at least to any extent, in the eastern part of the State, and particularly in the Charles River valley, within comparatively a few years. Aside from the vague traditions mentioned by Dr. Holmes, which he was unable to substantiate, there seem to have been only a few scattered sporadic cases of indigenous origin in this region. The most notable of these was perhaps the instance near Fresh Pond in Cambridge, mentioned above, because of the fact that in later years the epidemic in Cambridge seemed to have been most severe, and perhaps to have had its origin in the same spot. It is also important to call attention to the somewhat vague reports of cases of intermittent fever in Watertown, where the disease in later years first made its appearance in point of time in epidemic form. Whether this was the starting up of an old long latent source of the disease, or the place of first growth of the malarial parasite, imported from some other infected region, it seems impossible at this time to discover. It is interesting to note in this connection a point to which attention is called by Dr. Cook,¹ namely, that the Charles and Sudbury rivers, upon which intermittent fever appeared in endemic form at almost the same time, both have their origin in Hopkinton, a town where years ago the inhabitants used to be subject to the fever and ague. We have also seen that Hopkinton was one of the few places in eastern New England where Dr. Holmes was able to confirm by valid evidence the existence of intermittent fever in the past.

¹ Loc. cit., p. 283.

In November, 1894, circulars were sent out by the State Board of Health of Massachusetts to all the physicians living in towns along the Charles River above Watertown to Dedham. In these circulars three questions were asked:—

1. When did intermittent fever first appear in your town, judging from your own observation?
2. Has it been more or less prevalent in your town during the past five years than previously?
3. Have any measures been taken for its prevention, such as the drainage of wet lands, or other methods of improvement?

Physicians were also requested to add a list of the cases of intermittent fever occurring in their practice during the past five years, giving date, residence, results, whether it was indigenous or imported, and the type in each case. Eighty-four circulars were sent out, to which fifty-seven replies were received. These replies include not only one or more from each town, but at least one from each village in every town; and it is upon these reports, many of them very full and elaborate, that this paper is based. I wish here to return thanks to all the gentlemen who were at the pains to reply to the circular, and also to thank those of them to whom I am indebted for personal favors, in showing me the various towns and places most infected.

From the lists of cases reported, supplemented by verbal communications and by personal inspection when possible, a map was prepared for the use of the board. The endeavor was made to locate each case as accurately as possible, although in many instances this could not be done absolutely. One fact should be borne in mind in considering the distribution of cases—that in many places the scarcity of cases is due to the small population, and not to the rarity of the disease, many instances having been found where nearly every person in a small settlement had suffered from the disease, yet the total number of cases was still small.

Taking up the replies to the first question on the circular, “When did intermittent fever appear in your town, judging from your own observation?” and arranging them alphabetically by towns, we find these replies:—

BOSTON. As it was desired only to include the Charles River valley, circulars were sent only to the outlying districts of Boston, near the Charles River.

West Roxbury District. Dr. C. W. Sparhawk replies: "Oct. 1, 1890."

Jamaica Plain District. Dr. J. P. Broidrick places the appearance of the disease in 1892, Dr. A. S. Perry in 1891.

BROOKLINE. Dr. H. L. Chase reports "sporadic cases in 1885, and since 1889 near Hammond's Pond at Chestnut Hill the disease has been really endemic." Dr. Chase, in a paper on this subject,¹ aside from the Chestnut Hill cases, reports cases in Brookline in 1890, 1891 and 1892. Dr. H. M. Cutts writes: "I cannot find that I treated any cases of malaria in 1890, though I am sure that I saw several important cases. In the spring of 1891 the upturning of Muddy River bottom for park purposes started up malaria, though in my own practice I saw no indigenous cases." Dr. Sabine says "nine (?) years ago."

DEDHAM. Dr. F. L. Babcock writes: "Five or seven years ago. . . . It was never known here previous to seven or eight years ago, unless imported." Dr. E. W. Finn reports a case in September, 1892, but mentions no definite time of its appearance. Dr. J. P. Maynard writes: "About *forty years* ago, two cases in *one family*. None known to me for at least thirty-four years previous to that date. I have not learned of any cases (indigenous) since that period until within the last ten years."

DOVER. Dr. Cook² says physicians living in adjoining towns have mentioned cases in Dover, which would make the appearance date from 1889, at least. The earliest reported case of which mention is made in replies received during this investigation is one in August, 1891, reported by Dr. Mansfield of Needham.

NEEDHAM. Dr. H. T. Mansfield writes: "The first case I saw was one in 1879, severe and well defined." Dr. A. E. Miller says: "I had the first case Sept. 23, 1890. There have been but few cases here (unless imported), and these have been in the vicinity of the bicycle factory. A pond of water is in the rear of the factory. Pigs in large numbers have also been kept near there."

¹ H. L. Chase, M.D. Intermittent fever in Brookline. Boston Medical and Surgical Journal, Vol 127, p 565.

² Loc. cit., p. 262.

Dr. A. M. Miller says about 1889 or 1890; Dr. V. D. Miller gives 1890 as the date.

NEWTON. Dr. J. F. Frisbie says that the disease appeared more than five years ago. Dr. C. D. W. Reed gives 1888. Dr. R. A. Reed writes: "My first business on coming to Newton in 1881 was intermittent fever." Dr. L. R. Stone says he "cannot say with certainty." Dr. F. D. Webber gives the date as 1885.

Dr. Stearns of the Nonantum district of Newton gives the date of the first appearance of the disease as July, 1889. He writes: "I am a native and resident of that low part of Newton called Nonantum, situated near Watertown and Ætna Mills, and close to the Charles River. Our family have lived in the same place since 1640. My father, born here in 1820, remembers nothing of malaria in this section, nor remembers of his parents ever speaking about it. Malaria was known to exist ten miles up the river (South Framingham) a few years before it appeared here, and was quite epidemic in Newton Upper Falls and Auburndale the year before it appeared to any great extent here. It occurred here in pronounced shape *over a year before land was dug up* for sewers. The land was also dug up about twelve or fifteen years ago for water works, and not a single case appeared. In the parts where malaria is most epidemic—Auburndale and Newton Upper and Lower Falls—no sewer has yet been made, and no turning up of land occurred."

Dr. D. E. Baker of Newtonville places the appearance of the disease in 1886, Dr. W. O. Hunt in September, 1885, Dr. G. H. Talbot about 1887 and Dr. G. S. Woodman says in 1887 or 1888.

Dr. F. E. Crockett of West Newton gives five years ago as the time of the commencement of the disease. Dr. F. G. Curtis writes: "It was here when I came, in 1889."

Dr. M. H. Clarke of Auburndale writes: "In the fall of 1888 intermittent fever had just begun to make its appearance in Auburndale." Dr. F. E. Porter gives the date as 1884 or 1885. He says: "The exact year when intermittent fever came to my notice was when the city of Cambridge started to build a reservoir for water supply in the town of Weston, across the river from Auburndale, perhaps earlier or later than I mentioned in answer to your first question."

Dr. F. M. Sherman, formerly of Newton Lower Falls, first saw cases of the disease in 1890, but says that other physicians told

him the disease appeared some eight or ten years ago. Dr. Baker¹ states that he saw some of the earliest cases at Newton Lower Falls in 1885.

Dr. W. H. Hildreth of Newton Upper Falls gives September, 1887, as the date at which he first saw intermittent fever, Dr. W. H. McOwen gives the spring of 1888, and Dr. E. Thompson the year 1885.

Dr. J. R. Deane of Newton Highlands gives the date of the appearance of intermittent fever as 1886.

Dr. Loring of Newton Centre writes: "During my term in the Harvard Medical School we were taught that malaria was never to be seen in the vicinity of Boston. My surprise was great, *sixteen years* ago, in finding an occasional case of intermittent fever in Newton. The cases were rather infrequent then, say two or three a season. Six years ago, however, it came in force." That is in 1888. Dr. F. A. Sylvester says: "Twenty years since. . . . Cases seldom occurred, but occasionally, during the decade from 1875 to 1885, gradually increasing since 1885 to 1893."

WALTHAM. Dr. E. R. Cutler writes: "My first case was July 17, 1887." Dr. F. A. Foster gives no date, but reports a case in June, 1889. Dr. A. Greenwood states that he first saw it in the fall of 1891, upon coming to Waltham. Dr. I. S. Hall gives 1889. Dr. W. F. Jarvis says: "About five years ago." Dr. C. J. McCormick gives June, 1888. Dr. E. A. Sears says: "I found it here when I came, four years ago." Dr. H. A. Wood says: "My observation extends over but seven years of its existence." That is since 1887. Dr. A. Worcester gives 1888 as the date of its first appearance.

WELLESLEY. Dr. E. E. Bancroft writes that the disease made its appearance "in 1887. My practice in Wellesley began in 1887." Dr. W. B. Lancaster says: "Before I came to Wellesley Hills, which was four years ago this month (December, 1894)."

WESTON. Dr. F. W. Jackson writes: "Malaria has existed here during the summer months each year since 1885,"—the year when, as we have seen, the new reservoir for the city of Cambridge was begun in this town.

From these reports we see that intermittent fever has occurred, sporadically indeed, yet indigenously, in the Charles River valley

¹ Boston Medical and Surgical Journal, Dec. 15, 1892, p. 581.

for a longer time than has generally been supposed. Dr. Sylvester mentions cases in Newton twenty years ago, and scattered cases throughout the decade 1875-85. Dr. Loring also speaks of cases in Newton sixteen years ago. Dr. Mansfield reports a case from Needham in 1879, and Dr. Maynard of Dedham mentions two cases, occurring in a house situated upon a dam on Mother Brook, which certainly were forty years ago; but he saw no cases after that until ten years ago. We have seen that intermittent fever was frequent in Watertown in 1884. It seems to have appeared next, to any extent, in Weston in 1885. A number of cases occurred across the river from Weston in Auburndale the same year, and it became prevalent there in 1886. It also seems to have appeared in Newton Upper Falls in 1885, and at Newton Lower Falls the same year. During the years from 1886 to 1889 it appeared in epidemic form at Newton Centre (1888), West Newton (1889), Newtonville (1886 or 1887), Nonantum (1889), Chestnut Hill (1889) and Newton (1888 or 1889). At Newton Highlands it has been much rarer, but a number of cases have been seen each year since 1889. Thus we see that the disease in Newton appeared first at Auburndale, Riverside, Newton Upper Falls and Newton Lower Falls at nearly the same time, and has gradually spread, though in a somewhat irregular manner, yet in a general way, down the river, through the whole city. In Waltham it seems to have become endemic certainly as early as 1888, about the time that it began to prevail to any extent in the parts of Newton across the river, but four years later than at Watertown, just below upon the same side. Wellesley has suffered considerably since 1887, Dedham since 1888, Dover since 1889 and Needham also since 1889; though, as has been said, scattered cases were seen much earlier. In Boston and Brookline the disease can scarcely be said to be very prevalent as yet, and cases have only occurred since 1890.

Thus the beginning of the present outbreak of intermittent fever in the Charles River valley certainly antedates that of 1885 at Framingham, though it did not involve a large extent of territory until about two years later. We are compelled, therefore, to conclude that the outbreak in the Charles River valley did not have its origin in that at Framingham. Whether the disease was brought from towns near the source of the Charles, where it is known to have existed, seems doubtful, as our present knowledge of the

propagation of the disease tends to show that it is not spread by means of water; and the occurrence of even the few scattered indigenous cases during the decade 1875-85, and before, points to the presence of infected foci, which under favorable conditions have become starting-points for the wide-spread growth of the parasite in the infected region. In what way these foci originated, whether from others at the source of the river, as has been suggested, or from incysted forms of the parasite, lying dormant for many years, it is impossible to say, until further investigations have given us knowledge of the life history of the hæmatozoön outside of the human body, of which we now know nothing.

Let us now take up the question whether the disease has become more or less prevalent during the past five years. This was the second question upon the circulars sent out.

BOSTON. *West Roxbury District.* Dr. Sparhawk reports intermittent fever more prevalent during the past five years than previously.

Jamaica Plain. Dr. Broidrick also states that it has been more prevalent, and Dr. Perry says the same, and writes: "the disease appeared here about the time that ground was being broken for the park improvements."

BROOKLINE. Dr. Chase says that the disease has increased in amount. Dr. Cutts writes: "Yes; more prevalent, but it is at present markedly on the wane." Dr. Sabine says: "More; apparently more two years ago than before or since."

DEDHAM. Dr. Babcock writes that the disease is more prevalent, as do all the other doctors heard from in this town.

NEEDHAM. Dr. H. T. Mansfield writes; "More, and more so the last few years. I have seen a large number of cases in the past three years." Dr. A. E. Miller says: "More. Most of the cases have been near the Charles River along the Newton line." Dr. A. M. Miller and Dr. V. D. Miller both write that there has been more of the disease.

NEWTON. Dr. Frisbie, Dr. C. D. Whitman Reed, Dr. Scales and Dr. Stone all write that the disease has been more prevalent. Dr. R. A. Reed says: "Not more prevalent, I should say, except perhaps the past summer." Dr. Webber writes: "Generally speaking, the disease has increased. During the past year the severity of the disease has been more noticeable."

From Nonantum Dr. Stearns says that the disease has been more prevalent, and adds: "This year, as well as last year, many people have learned to treat the disease themselves, so that perhaps somewhat accounts for the falling off of cases, yet it really does seem as if Nonantum and Ætna Mills and Watertown have not so much malaria as in previous years. Whether the surface drainage put in at the time of [the construction of] the sewer has anything to do with it, or not, I cannot say. My experience in Auburndale and Upper and Lower Falls is that malaria has increased in that section the past year (the *sewer* and underdrain has not been put in in the above section)."

From Newtonville Dr. Baker says that intermittent fever has been more prevalent. Dr. Hunt says: "Less until this year. There has been much more malaria this year than for several years. In the Upper Falls they have it all the time, also much in Lower Falls. Of late many cases have appeared in Auburndale, on high as well as low lands. Many on the West Newton hill. More than usual in Newton proper." Dr. Talbot says there has been more. Dr. Woodman says: "More; particularly during the excavations along our streets for laying the sewer."

All the physicians of West Newton report the disease as more prevalent. Dr. Curtis writes: "In regard to your question as to the prevalence of intermittent fever during the past five years, there has been a steady increase up to the present year, when there has seemed to be a decrease, typhoid apparently taking its place. I am not yet prepared to say how great the increase in typhoid has been this year over last, but it is quite marked, I feel sure. In regard to malarial diseases, I sent a letter in the latter part of August to the physicians of Newton, asking for a report as to the increase or decrease over last year. Out of twenty-three replies, sixteen reported a decrease. In the Newton hospital during the last six or seven years there has been a steady decrease in typhoid, malarial diseases taking its place, until the present season, when the pendulum has swung the other way."

Dr. Clarke of Auburndale writes that when intermittent fever first appeared in Auburndale "it was confined principally to Charles Street, Auburndale, a street which ends at the Charles River. . . . I saw perhaps fifteen or twenty cases that fall (1888). In the spring and summer of 1889 the disease extended from Charles Street up

through the village of Auburndale, along Hancock Street, with occasional cases on the side streets and hills, until it reached the end of Hancock Street, about the end of the summer. The cases at Riverside (Charles Street) still continued to be most numerous. Since that time the cases have increased in number, the excavations for the sewer two or three years ago seeming to start up a new set of cases, which followed these excavations pretty closely. During the year 1894 I have treated about one hundred cases of intermittent fever, and, while the number is larger than any preceding year, the type of the disease seems to be milder, and more amenable to treatment. As a whole, I will conclude by saying that, although the number of patients suffering from malarial fever has increased, the disease seems to have lost in virulence. . . . My total number of cases in the last six years must aggregate, I think, between two and three hundred."

Dr. F. E. Porter, also of Auburndale, writes: "For chart purposes, unless it is published by years, it is safe to say there is not a street in Auburndale that has not been visited in some of its parts, in some year or years, with malaria. Of course some sections have had many returns of the disease. This last statement should not convey the idea that it is especially visited beyond others of the towns about us. Other physicians, as familiar with neighboring wards or towns as I with this, may not word their statements to match this; but from what I know and hear, in Newton, the extent of this disease has in some degree been in accordance with the amount of exposed and upturned soil. . . . By upturned soil, attention is called to cellar digging and street laying, but particularly the extension of the State park system in the 'Newton boulevard,' so called, which this past year and more has been employing many laborers in this and the adjacent wards. Many have had malaria. For about the same length of time the city sewer works have been busy, employing perhaps a larger number of men . . . some of whom have contracted malaria, and were sent to the Newton hospital. So that I think a full statement from Newton would not be received unless that hospital contributed to the report.¹ In other years, whenever these two industries worked, the report shows an increase of malaria. . . . So, after all, I think there has been more malaria the last year or two here than before."

¹ This has been received.

Dr. Sherman, formerly of Newton Lower Falls, writes: "During the four years from January, 1890, to January, 1894, intermittent fever has been exceedingly prevalent; in my opinion, has rather increased than otherwise. I have left the place for the reason that I myself and my family have suffered so much from the disease. Taking the whole population of the village, there are but few individuals who have not had repeated attacks. There are very few houses within a radius of a mile of Newton Lower Falls where during this time cases of intermittent fever have not developed. The cases are to be numbered not by dozens, but by hundreds. The disease seems to prevail as much upon the high land about the village as in the valley and along the river banks."

All the physicians at Newton Upper Falls think that the disease has increased during the last five years.

Dr. Deane of Newton Highlands writes: "This year there have not been as many cases at Newton Upper Falls as in 1892 and 1893, but more at Newton Lower Falls, Riverside, Auburndale, Waltham and West Newton, also some at Nonantum and Newton proper." He says that there has been very little at Newton Highlands itself.

Dr. Loring of Newton Centre writes that the disease appeared in 1888, and adds: "During the following four years all the physicians had many cases. It was the common disease from late spring until late autumn. . . . It is no exaggeration to say that during the last six years I have treated over three hundred cases of malaria. . . . During the last two years the disease has been growing less severe, and the cases are less frequent." Dr. May says that the prevalence of the disease has been greater during the last five years than previously, "except that in this ward (6) for the past year it has been less prevalent." Dr. Sylvester also reports the disease as more prevalent, "gradually increasing since 1885 to 1893, and decreasing materially since, with comparatively few cases during 1894, and most of these near the Charles River."

WALTHAM. Dr. Cutler writes: the prevalence of the disease "has varied from year to year, but it has prevailed extensively every year. I saw but one indigenous case in Waltham previous to the above date (July 17, 1887). Have practised here twenty-five years." Dr. Greenwood reports: "More every year." Dr. Hall: "Much more." Dr. Jarvis, Dr. McCormick and Dr. Sears all state that the disease has increased in amount. Dr. Wood

writes: "I can say that during my seven years' residence in Waltham this year has shown me the largest number of cases, partly because of my increased practice, and partly from its greater prevalence." Dr. Worcester also agrees that it has been more prevalent.

WELLESLEY. Dr. Bancroft says there has been more intermittent fever in Wellesley during the past five years than previously. Dr. Lancaster of Wellesley Hills writes that there has been much more intermittent fever during the past five years, and adds: "We have less malaria here at Wellesley Hills than at Wellesley, and not anywhere near as much as at Newton Lower Falls."

WESTON. Dr. Jackson says that the disease has been more prevalent, and then adds further: "Malaria has existed during the summer months each year since 1885, but more so this season." And again: "Malaria has this year (1894) prevailed to an extent hitherto unknown in the Stony Brook section of Weston;" and mentions in this connection the fact that the water of the Stony Brook reservoir of Cambridge was drawn down lower than usual that summer. He also says that when the wind blew steadily in one direction across the reservoir new cases would be seen on the opposite side of the reservoir from that from which the wind blew, and when the wind blew in the opposite direction, cases would appear upon the other side.

Before considering these replies, let us first see what we find from the cases reported by the physicians of the various towns; and it should be stated, first, that these figures include only a portion of the cases reported, as it has been only possible to analyze them by towns and years when both date and residence were given.

The cases from the outlying districts of Boston and Brookline are too meagre to be of much value in determining the spread of the disease, as it seems scarcely to have become endemic as yet.

<i>West Roxbury.</i>						<i>Jamaica Plain.</i>					
					Cases.						Cases.
1890,	.	.	.	.	4	1890,	.	.	.	.	-
1891,	.	.	.	.	7	1891,	.	.	.	.	2
1892,	.	.	.	.	6	1892,	.	.	.	.	9
1893,	.	.	.	.	5	1893,	.	.	.	.	2
1894,	.	.	.	.	-	1894,	.	.	.	.	4
Total,					22	Total,					17

IMPROVEMENT OF CHARLES RIVER.

<i>Brookline.</i> ¹						<i>Boston and Brookline.</i>					
					Cases.						Cases.
1890,	.	.	.	.	7	1890,	.	.	.	.	11
1891,	.	.	.	.	11	1891,	.	.	.	.	20
1892,	.	.	.	.	16	1892,	.	.	.	.	31
1893,	.	.	.	.	5	1893,	.	.	.	.	12
1894,	.	.	.	.	9	1894,	.	.	.	.	13
Total,	.	.	.	.	48	Total,	.	.	.	.	87

<i>Dedham.</i>						<i>Needham.</i>					
					Cases.						Cases.
1890,	.	.	.	.	—	1890,	.	.	.	.	7
1891,	.	.	.	.	1	1891,	.	.	.	.	8
1892,	.	.	.	.	3	1892,	.	.	.	.	20
1893,	.	.	.	.	3	1893,	.	.	.	.	16
1894,	.	.	.	.	5	1894,	.	.	.	.	11
Total,	.	.	.	.	12	Total,	.	.	.	.	62

<i>Newton (proper).</i>						<i>Nonantum.</i>					
					Cases.						Cases.
1890,	.	.	.	.	1	1890,	.	.	.	.	30
1891,	.	.	.	.	7	1891,	.	.	.	.	120
1892,	.	.	.	.	4	1892,	.	.	.	.	80
1893,	.	.	.	.	9	1893,	.	.	.	.	90
1894,	.	.	.	.	7	1894,	.	.	.	.	70
Total,	.	.	.	.	28	Total,	.	.	.	.	390

<i>Newtonville.</i>						<i>West Newton.</i>					
					Cases.						Cases.
1890,	.	.	.	.	25	1890,	.	.	.	.	19
1891,	.	.	.	.	45	1891,	.	.	.	.	20
1892,	.	.	.	.	30	1892,	.	.	.	.	8
1893,	.	.	.	.	51	1893,	.	.	.	.	8
1894,	.	.	.	.	20	1894,	.	.	.	.	15
Total,	.	.	.	.	171	Total,	.	.	.	.	70

<i>Auburndale.</i>						<i>Newton Lower Falls.</i>					
					Cases.						Cases.
1890,	.	.	.	.	35	1890,	.	.	.	.	139
1891,	.	.	.	.	25	1891,	.	.	.	.	38
1892,	.	.	.	.	12	1892,	.	.	.	.	3
1893,	.	.	.	.	16	1893,	.	.	.	.	9
1894,	.	.	.	.	8	1894,	.	.	.	.	6
Total,	.	.	.	.	96	Total,	.	.	.	.	195

¹ Years 1890-92, from H. L. Chase, M.D. Intermittent fever in Brookline. Boston Medical and Surgical Journal, Vol 127, p. 565.

<i>Newton Upper Falls.</i>		<i>Newton Highlands.</i>	
	Cases.		Cases.
1890,	—	1890,	1
1891,	—	1891,	—
1892,	9	1892,	—
1893,	26	1893,	5
1894,	16	1894,	2
Total,	51	Total,	8

<i>Newton Centre.</i>		<i>Chestnut Hill.</i>	
	Cases.		Cases.
1890,	7	1890,	4
1891,	3	1891,	20
1892,	21	1892,	40
1893,	32	1893,	30
1894,	30	1894,	35
Total,	93	Total,	129

The Newton hospital, situated in West Newton, but drawing cases from all of Newton, reports cases as follows:—

Newton Hospital.

	1890.	1891.	1892.	1893.	1894.	Totals.
Newton Centre,	4	2	3	3	4	16
Newton Highlands,	1	—	—	—	—	1
Newton Upper Falls,	—	—	—	1	—	1
Newton Lower Falls,	2	—	1	7	2	12
Auburndale,	5	3	—	5	2	15
West Newton,	9	3	3	—	5	20
Newtonville,	1	7	6	—	—	14
Newton,	1	5	1	3	1	11
Totals,	23	20	14	19	14	90

Newton (Totals).

YEARS.	Cases given Above.	Cases given without Residence, but with Year.	Total.
1890,	257	130	387
1891,	258	280	538
1892,	167	1,013	1,180
1893,	246	922	1,168
1894,	174	819	993
Totals,	1,102	3,164	4,266

<i>Waltham.</i>					<i>Wellesley.</i>				
				Cases.					Cases.
1890,	.	.	.	33	1890,	.	.	.	—
1891,	.	.	.	63	1891,	.	.	.	9
1892,	.	.	.	61	1892,	.	.	.	20
1893,	.	.	.	73	1893,	.	.	.	19
1894,	.	.	.	204	1894,	.	.	.	10
Total,	.	.	.	434	Total,	.	.	.	58

Weston.

Total, 1890-95, about 100 cases.

Total reported Cases, by Years.

	Cases.
1890,	442
1891,	659
1892,	1,355
1893,	1,291
1894,	1,236
Total,	4,983

	Total Cases.	Population (Census of 1890).	No. Cases per 1,000 of Population.
Brookline,	48	12,103	3.96
Dedham,	12	7,123	1.68
Dover,	—	727	—
Needham,	62	3,035	20.42
Newton,	4,266	24,379	174.98
Waltham,	434	18,707	23.09
Wellesley,	58	3,600	16.11
Weston,	100	1,664	60.09

Brookline,	1 case to 254.14 of population.
Dedham,	" " 593.66 " "
Needham,	" " 48.95 " "
Newton,	" " 5.71 " "
Waltham,	" " 43.10 " "
Wellesley,	" " 62.07 " "
Weston,	" " 16.64 " "

Cases per 1,000 Population, by Years.

<i>Brookline.</i>						<i>Dedham.</i>					
					Cases.						Cases.
1890,	.	.	.	.	0.90	1890,	.	.	.	.	—
1891,	.	.	.	.	1.65	1891,	.	.	.	.	0.14
1892,	.	.	.	.	2.56	1892,	.	.	.	.	0.42
1893,	.	.	.	.	0.99	1893,	.	.	.	.	0.42
1894,	.	.	.	.	1.07	1894,	.	.	.	.	0.70

<i>Needham.</i>						<i>Newton.</i>					
					Cases.						Cases.
1890,	.	.	.	.	2.30	1890,	.	.	.	.	15.87
1891,	.	.	.	.	2.63	1891,	.	.	.	.	22.06
1892,	.	.	.	.	6.58	1892,	.	.	.	.	48.46
1893,	.	.	.	.	5.27	1893,	.	.	.	.	47.91
1894,	.	.	.	.	3.62	1894,	.	.	.	.	40.73

<i>Waltham.</i>						<i>Wellesley.</i>					
					Cases.						Cases.
1890,	.	.	.	.	1.60	1890,	.	.	.	.	—
1891,	.	.	.	.	3.36	1891,	.	.	.	.	2.50
1892,	.	.	.	.	3.26	1892,	.	.	.	.	5.50
1893,	.	.	.	.	3.90	1893,	.	.	.	.	5.27
1894,	.	.	.	.	10.90	1894,	.	.	.	.	2.77

The following table, compiled from all the cases reported in which the month was given, shows well the range by months:—

Total Reported Cases, by Months.

January,	.	.	.	.	15	July,	.	.	.	.	329
February,	.	.	.	.	10	August,	.	.	.	.	411
March,	.	.	.	.	31	September,	.	.	.	.	491
April,	.	.	.	.	89	October,	.	.	.	.	245
May,	.	.	.	.	227	November,	.	.	.	.	93
June,	.	.	.	.	291	December,	.	.	.	.	11

In the parts of Boston included in this investigation the opinion of the physicians heard from has been unanimous that the disease has been more prevalent during the past five years than previously. In Brookline, while the same is true, it seems at present to be diminishing. An increase has also been noted in Dedham and Needham, and in these towns the disease does not seem to have begun to diminish. In Newton, both from the statements of physicians and from the number of cases reported, intermittent

fever seems to have been more prevalent two years ago than at present, with a decided increase during the last five years over the preceding five years. This, however, does not hold true of all parts of the city. In Newton proper, Nonantum, West Newton, Newton Lower Falls, Newton Upper Falls and Newton Centre it has apparently begun to diminish; while at Newtonville and Auburndale it is still upon the increase, though the general opinion of physicians is that the cases are less severe in type. In Waltham the disease is apparently still upon the increase, diminishing again in Wellesley, and still increasing in Weston.

In general, judging both from the numbers of cases reported and from the opinions of physicians, obtained both by correspondence and personally, the conclusion seems to be justified that the maximum prevalence of intermittent fever in the regions under investigation was attained in the years 1892 and 1893, and that since that time it has diminished slightly in extent, and still more in the severity of the cases. Nevertheless, the increased tendency of patients to treat themselves when attacked by intermittent fever, of which nearly all the physicians speak, in part perhaps due to the financial difficulties experienced by so many persons since the summer of 1893, and considering also the statements of life insurance examiners, that, upon asking what was the most recent disease from which the applicant had suffered, the almost invariable reply has been "malaria," both of these facts make this conclusion, that the disease is diminishing, more or less doubtful. The statement that the severity of the cases has diminished is much more reliable.

Let us now take up the replies to the third question of the circular, "Have any measures been taken for its prevention, such as drainage of wet lands, or other methods of improvement?"

BOSTON. The report from West Roxbury is that nothing has been done. The replies from Jamaica Plain are to the effect that the only measures of improvement have consisted in the drainage of the park lands.

BROOKLINE. Negotiations have been begun between the Newton and the Brookline boards of health as to the possibility of draining the rotten land around Hammond's Pond, at Chestnut Hill. Surveys have been made, but no money has as yet been voted.¹ Dr.

¹ Report of the Board of Health of Brookline for the year ending Jan. 31, 1893, p. 8; report of the Board of Health of Brookline for the year ending Jan. 31, 1894, p. 8.

Curtis writes: "At Chestnut Hill, when there was much malaria in a small area, drainage of wet lands was undertaken. Incidentally the turning of Muddy River bottom into a park has checked, possibly stopped, malaria along its banks."

DEDHAM. Dr. Finn writes: "The Board of Health have endeavored to drain Wigwam Pond and the surrounding meadows by building new and widening the old drains, which empty into the Charles River." Dr. Babcock says: "But very little has been done, as the high water of the Charles River gives but little fall, preventing drainage of most of our objectionable lands." Dr. Maynard makes essentially the same reply, saying that efforts at drainage have been made, "but the meadows cannot be drained below the level of the Charles River."

NEEDHAM. Dr. Mansfield replies that nothing has been done of which he knows. Dr. A. M. Miller reports one instance of drainage of wet lands. None of the other physicians of this town know of anything that has been done.

NEWTON. At Newton proper the only improvements which have been made, so far as could be learned, have been slight, except the extension of the sewerage system and drainage in what is known as the Boyd's Pond district. At Nonantum there have been the introduction of the "metropolitan sewer" and considerable work on surface drainage, particularly along the lower part of Cheese Cake Brook, chiefly in connection with the making of the Cheese Cake boulevard. From Newtonville Dr. Baker writes: "Newton has partly completed a sewerage system with subdrains for ground water, and the Board of Health has drained several wet tracts surrounded by cases of malaria." Dr. Woodman says: "Of course the ultimate object of the sewer is to relieve our community from liability to the prevalence of zymotic and other diseases." Dr. Curtis says there has been the introduction of a system of sewers, but no systematized attempt to improve wet land. Part of the shallowest portion of Bullough's Pond has been filled up, and Laundry Brook, leading from it to Boyd's Pond, has been deepened in some places. Dr. Crocket of West Newton writes, in answer to the question whether any measures of prevention have been taken: "No; but sewer drains have been added which have dried up wet lands in many places." Dr. Clarke of Auburndale speaks as follows: "A former pond on Melrose Street, which was filled up

about two years ago, seems to have been a nucleus for intermittent fever, and scarcely any house in the neighborhood has escaped. . . . So far as I know, with the exception of the river, praiseworthy efforts have been made in the way of drainage. The pond on Melrose Street, previously mentioned, and a bog on Woodbine Street have been drained, I believe." Dr. Porter of Auburndale also speaks of measures of prevention now in progress. From Newton Upper Falls Dr. Hildreth reports that nothing has been done; while Dr. McOwen writes: "Nothing in the vicinity of Newton Upper and Lower Falls. In some other parts of Newton the brooks and rivulets have been improved, that is, their banks have been sloped and graded (beautified). They have been building a system of sewerage in some parts of Newton for the past three years." Dr. Deane of Newton Highlands says that nothing has been done in that neighborhood in the way of drainage or other methods of prevention. Dr. May of Newton Centre speaks only of the sewers which have been built, as tending to drain certain localities; and Dr. Sylvester writes in the same general way. The low meadow lands in the vicinity of Reed's Corner and Auburndale, which are separated from the Charles River by Lexington Street, which is here in part upon an embankment, have been drained, or at least an attempt, only partially successful, has been made to drain them.

WALTHAM. The only things which have been done in Waltham by way of prevention of the disease, by better drainage, are the extensive introduction of surface drainage and the connection made with the metropolitan sewer, reported by Dr. Hall and Dr. Jarvis.

WELLESLEY. At Wellesley and Wellesley Hills no measures of prevention have been taken.

WESTON. Dr. Jackson writes, in answer to the third question: "Partially; only in the centre of Weston, where several acres of wet, boggy, spongy land was drained."

Resuming, then, we find that in Boston the drainage incident to the construction of the new park system has been constructed, which also affects Brookline. Brookline and Newton are negotiating for the adoption of some plan for the improvement of the region about Hammond's Pond. Newton has extended her sewerage system, and in Nonantum, Newtonville, West Newton and Auburndale more or less has been done in the way of surface drainage and

filling up certain ponds, though these attempts are scattered and not systematized. At Dedham, again, some efforts have been made to drain some of the marsh lands, while at Needham practically nothing has been done. At Waltham, aside from the extension of the present sewerage system and some attempts at surface drainage, no systematic efforts have been made to check the disease. In Wellesley nothing has been done, and in Weston some wet lands in one part of the town have been drained; but elsewhere in the town, and especially in the neighborhood of the Cambridge reservoir, where intermittent fever is most abundant, nothing has been done.

It is hardly possible, in a paper of this description, to endeavor to give any extended historical account of the discovery of the parasite of malaria, or of what is known of its life history. It was discovered by the French physician and professor, Laveran, on Nov. 6, 1880, and the first report of this discovery was his note to the Academy of Medicine in Paris, at the meeting of Nov. 23, 1880.¹ This discovery was confirmed by the researches of Richard² in Algeria. In 1882 Laveran went to Rome, in order to learn if these organisms occurred with the same regularity in the blood of malaria patients there as he had found them elsewhere. Here, met at first with unbelief by the Italians, he finally convinced them. Marchiafava and Celli³ turned their attention to the study of this new organism, although they did not accept the view that the bodies seen in the red corpuscles of the blood in malaria were parasites until the year 1885. Then followed the work of Sternberg,⁴ Councilman,⁵ Osler,⁶ Maurel,⁷ James,⁸ Sacharoff,⁹ Paltauf,¹⁰ Plehn,¹¹ Quincke,¹² von Jaksch,¹³

¹ A. Laveran. Note sur un nouveau parasite trouvé dans le sang des plusieurs malades atteints de fièvre palustre. Note communiquée à l'Académie de médecine, Séance du 23 nov., 1880.

² E. Richard. Sur le parasite de la malaria. Comptes rendu, 1882, Séance du 20 février.

³ Marchiafava and Celli. Die Veränderungen der rothen Blutkörperchen, etc. Fortschritte der Medicin, I Bd., 1883. The same. Memoire della R. Acc. dei Lincei, 1883, and elsewhere.

⁴ Sternberg. The malarial germ of Laveran. Medical Record, New York, 1886

⁵ Councilman. Fortschritte der Medicin, 1888, No. 12-13.

⁶ Osler. British Medical Journal, 1887, p. 556.

⁷ Maurel. Recherches microscopiques sur l'étiologie du paludisme. Doin. Paris, 1887.

⁸ James. The microorganisms of malaria. Medical Record, New York, 1888, p. 269.

⁹ N. Sacharoff. Ref. im Centralblatt für Bakteriologie. 1889, S. 452.

¹⁰ Paltauf. Wiener klinische Wochenschrift. 1890.

¹¹ Plehn. Aetiologische und klinische Malariastudien. Hirschwald. Berlin, 1890.

¹² Quincke. Neber Blutuntersuchungen bei Malariakranken. Mittheilungen des Vereines Schleswig-Holst.Aerzte, 1890.

¹³ R. v. Jaksch. Prager medicinische Wochenschrift. 1890.

and Mannaberg,¹ to say nothing of the later writings of Laveran himself, which have placed our knowledge upon a firm basis, though there are still portions of the complete proof lacking. That the disease is due to this organism is certain. The parasite is probably closely allied to the coccidia rather than to the amœbæ; and Mannaberg,² in speaking of the relation of this form to others, thinks that, in accordance with the present position of the matter, we may surmise with considerable certainty that a special subclass will have to be formed of the parasites found in the blood. This subclass will have to be made in the class of the spirozoa, along with the subclasses of the gregarinida, coccidia, myxosporidia and sarcosporidia, and he suggests the name of hæmosporidia. Hæmatozoön, however, is the name proposed by Laveran for the parasite of malaria. Whether this parasite of the blood exists as a saprophyte, or as a parasite outside of the body, we do not know. In fact, while we know its life history in the blood with a considerable degree of accuracy, we know absolutely nothing of it as it exists outside of the human body. Nor do we know its relation to the intracorpuseular bodies found in the blood of certain birds. We know only that it grows in moist, marshy soil, and that it probably enters the body by means of the air, and not in the water we drink. The evidence in favor of the latter method of infection, as in the instance of the outbreak of malaria upon the ship "Argo," which is communicated by Boudin, and other cases where the disease is supposed to have been transmitted through drinking water, is not conclusive, while we have very strong experimental evidence to the contrary.³

The important conditions under which malaria breaks out and spreads are, as is known, slight porousness of the soil, a moderate amount of moisture and warmth; and we must acknowledge that these conditions which we have just mentioned are the conditions which are favorable to the life of a low organism, whether it be of parasitic or of saprophytic nature. These external conditions favoring the spread of malaria have been known for years, and were well and carefully studied long before Laveran's discovery made known to us the organism which requires them for its growth. I cannot do better than quote from the article of Klebs and Crudeli⁴ in this

¹ Mannaberg. Die Malariaparasiten. Hölder. Wien, 1893.

² Loc. cit., p. 84.

³ See Marchiafava and Celli. Fortschritte der Medicin, 1885, Nos. 11 and 24.

⁴ Klebs and Tommasi Crudeli. Reale Acad. dei Lincei, Roma, 1878-9, and also New Sydenham's Translation, London, 1888.

connection: “*In marshy lands* its [the malarial poison’s] production is *nil*, or very slight, even when the temperature is very high, *so long as the marsh bottom is separated from the air by a sufficient layer of water*. It grows gradually during the hot season, as the evaporation diminishes this water, and attains its maximum when a great part of the marsh is uncovered, or only separated from the atmosphere by a thin covering of water.” And again: “Hygienic researches have hitherto been directed to the physical conditions which favor malaria production in non-marshy lands. All these contain a notable quantity of water in the rainy season, either from their low level or the slight permeability of the subsoil which underlies them. During the hot season this production may take place in the upper strata of the soil, where these remain sufficiently damp. . . . If, on the other hand, the ground is uncovered, the summer evaporation may entirely dry the superficial, but does not ordinarily go on to the exhaustion of the lower strata, which may preserve a remarkable degree of humidity till the return of the next wet season. Malaria cannot originate in these superficial strata, remaining dry, but does so in the remaining underlying ones, whenever the air is able to gain access to them through fissures or the porosity of the soil, or when excavations lay them bare.” Still further: “The subterranean marshes are harmless, even when they remain wet during the dry season, if the soil of the *colmata* (an embankment, — levelling up of hollow places with earth) covering them is deep and sufficiently compact. On the other hand, they generate malaria when only separated from the air by a thin stratum of disintegrated soil, or when the air can reach them owing to excavations or fissures in the overlying soil.”

Laverañ, in his monograph upon malarial fevers, reaches similar conclusions. He says:¹ “It seems probable to me that the hæmatozoön of malaria exists in marshy habitats in the state of a parasite of some animal or some plant.” Again:² “Malaria is essentially an endemic disease. One can mark out the zones in which it is dominant, just as naturalists indicate the regions in which one meets this or that plant, in which one observes this or that species of animal.” And further:³ “Moist, uncultivated, marshy places furnish a very propitious surrounding for malaria.

¹ A. Laverañ. Du Paludisme, et de son Hématozoaire, G. Masson, Paris, 1891, p. 147.

² Loc. cit., p. 151.

³ Loc. cit., p. 152.

The existence of a marsh, properly speaking, is not necessary; and, on the other hand, all marshes are not fever-producing, even in warm countries. . . . If a marsh, properly speaking, is not necessary, there must be at least *moist earth*. Malarial fevers do not arise upon ships at sea; in tropical countries, when the soil has been for a long time dried up, the fevers disappear; the rain, especially when it does not last too long, restores to the soil its fever-producing power. The scanty rains which come towards the end of the summer in warm countries, and which are soon dried up by the sun, are known to be very dangerous. Abundant rains, which last for a long time, have not the same disadvantages, especially if at the same time the temperature falls. The influence of warmth is evident from the distribution of malaria upon the surface of the earth. Endemic malaria, unknown in cold countries, increases in intensity as one goes toward the equatorial regions. In the temperate and hot zones it does not prevail except in the warm season; it reappears each year with the same regularity as this or that vegetable or animal species. . . . The influence of altitude, which cannot be doubted, is explained in large part by the fall of temperature, and also by the fact that upon higher ground, the water having an easy outlet, the soil is drained naturally. . . . A very slight altitude suffices to protect from the fever, and this fact is extremely important as regards prophylaxis. I have noted above that in the interior of the city of Constantine attacks of the fever were rare, while at a distance of a hundred metres below, near the gates of the city, malarial fever reigns with notable intensity on the banks of the Rummel. . . . In swampy countries the inhabitants of the upper stories of the houses are less exposed than those of the ground floor. . . . The germs of malaria rise with considerable difficulty in the atmosphere. The winds which pass over a marshy country may carry these germs, but not to any great distance."

As we see, areas of moist, undrained or poorly drained land, exposed to the air in parts, form the most favorable places for the growth of the parasite of intermittent fever. The soil of the Charles River valley, in its lower portion, consists mainly of sand and gravel, with here and there numerous true and false drumlins. There is not much peat and but very little clay, and nowhere any extensive layer of clay lying below the superficial soil, and forming

pockets capable of retaining moisture and increasing the difficulties of draining moist lands. Both along the river itself and beside the various tributary streams is found much swampy and poorly drained ground. Not only is this true, but in many places the river itself spreads out over a considerable area, forming extensive shallows, surrounded by a wider or narrower strip of marsh. At seasons when the water in the river is low, many of these shallows are exposed, or partially exposed, to the air and sun, while still retaining abundance of moisture, — in other words, forming most favorable culture grounds for the malarial parasite. This exposure of large areas of surface, when the level of the water is lowered but a few inches, is seen not only in the bed of the Charles River but along many of its tributaries and in many of the ponds which lie scattered through the whole region, and even more in the case of artificial reservoirs constructed for manufacturing purposes or for supplying water to neighboring towns and cities. In a report for the city of Newton upon a plan for drainage,¹ the engineers making the report, in speaking of the banks of the Charles River, say: "The shores of the Charles River, both on the side nearest Newton and on the opposite side which lies in the towns of Weston and Needham, have for a considerable portion of their length a margin of low land lying between the present high and low water marks." These marked variations in the water level, because of the exposure thereby of large areas of swamp to the action of the air and sun, form one of the most difficult problems to treat, in any plan for the abatement of the disease.

The prevalence of intermittent fever near excavations also requires notice. This has been referred to in the remarks of Klebs and Crudeli, quoted above, who speak of the growth of the micro-organisms in moist understrata of the soil, when the air is given access to these lower strata by excavations or other means. This is a sufficient explanation for all cases noted near excavations, as those in Newton, spoken of by physicians as occurring along the line of the excavations for the new sewerage system of the city, or in connection with the work upon the new park and boulevard systems. This, too, must be the explanation of the outbreak at the School for Feeble-minded at Waltham, mentioned by Dr. R. W. Greenleaf.

¹ Report of Albert F. Noyes, city engineer, and Edward A. Buss, C.E., on a plan for surface drainage for the city of Newton, Mass., Dec. 12, 1892. Newton Upper Falls, 1893, p. 16.

He says:¹ "Four or five large buildings have recently been erected here. They are on a hilltop, some two miles from the river. One of the buildings was built over an excavation made through a considerable amount of decaying forest growth. Almost immediately after occupancy nearly every inmate was seized with malarial disease. Two of the other buildings presented somewhat similar conditions. On another part of the hilltop four buildings were placed in a quadrangle; one was the executive building, one the school building and the other two were occupied as dormitories, one for boys, the other for girls. The boys' dormitory was constructed on land which had been cleared and well drained for a great many years; the girls' dormitory was built on the same hilltop, but on a part covered with forest growth. The conditions otherwise, including milk, water, supplies, etc., were the same. When these buildings were occupied, scarcely a case occurred in the boys' dormitory, but the girls were taken sick, five or six of them a day, until a considerable number of them were affected with intermittent fever." Dr. Greenleaf concludes that the germs have been present in this region since the early outbreak, when the country was first settled, and that the present prevalence of the disease was largely brought about by the digging incident upon the increase of building and other improvements during the last few years. Certainly the admittance of air to lower moist strata of earth, where the micro-organism is present, facilitates and even makes possible its growth, before impossible, and so may produce outbreaks in the neighborhood of excavations. This has been shown in numerous instances in other countries, where cases have broken out in regions where none had occurred for years, when digging was begun in places where a former marsh had been filled in. Such instances have undoubtedly occurred in the region under consideration; but that disturbance of the soil is not essential is proved by all we know of the origin of the disease, and in this particular instance by the testimony of many observers as to the occurrence of cases where no excavations were in progress; as Dr. Stearns of Nonantum, already quoted above, who states that intermittent fever occurred in Nonantum to a marked extent over a year before land was dug up for sewers and other improvements in that region.

We must now briefly consider the means of prevention of the

¹ Boston Medical and Surgical Journal, Sept. 6, 1894, p. 240.

disease. Speaking upon this portion of the subject, Laverañ says:¹ "Among the most efficacious measures of sanitary improvement must be cited the drying up of marshes, the drainage and the cultivation of the soil. By drying the soil, by draining it by mechanical procedures or by means of plants, one evidently modifies the conditions under which the parasites of malaria develop, and renders them less favorable to the increase of these organisms.

"Drainage of marshes ought only to be undertaken with methodical supervision, and with great precautions, especially in warm countries. One should take advantage of the season during which endemic malaria does not exist, or exists with the least intensity. During the hot season one should avoid uncovering a large surface of the marsh. The marsh is in fact much more dangerous when it begins to dry than when it is completely covered with water. The example of Lancisi, who had the moat of the Castle of St. Angelo flooded, to arrest the ravages of malaria, is celebrated. In Holland the same means have been employed more than once with success.

"The workmen employed in draining should not pass the night in the marshes, and should be subjected to preventive medication by quinine during the fever season.

"Systematic cultivation always purifies the soil, but certain varieties of plants are particularly useful for this purification. The plantations of eucalyptus trees which have been made for a score of years in a large number of swampy regions have already rendered great service, notably in Corsica, Algeria and Italy."

Intermittent fever has become endemic in the Charles River valley, — of this there can be no doubt. While the number of cases reported in this investigation for the earlier years is certainly too small, because of the difficulty of obtaining complete records of anything after a few years have intervened, yet, even after allowance has been made for this fact, it seems probable that we should still find an increase in the last years over the earlier years of the period included in this investigation. Our figures also show that, if the disease has begun to diminish as a whole in this region, the diminution is as yet slight. These conclusions are borne out by the fact that the individual physicians in this region as a rule agree that the disease is still increasing in extent, though perhaps losing

¹ Loc. cit., p. 214.

in virulence. We have also seen that up to the present time very little has been done in the way of preventive measures. We know that intermittent fever is to a great extent a preventable disease. The hæmatozoön, which is its cause, grows, whether as a parasite or not, only under certain conditions. These conditions are: first, warmth; second, moisture; and third, air. The first of these cannot be modified over large areas of country, such as those with which we have to do in this case. The last two can be modified. In what way? Moisture can be diminished, by proper drainage or by cultivation. Air can be excluded, either by covering the infected areas to a sufficient depth with dry, gravelly earth or sand, or by flooding them permanently with water.

The question of the Charles River itself is more difficult, as it is complicated by factors which do not enter into most cases. Chief among these is the fact that the river is used for manufacturing purposes, and that at present the rise and fall of the river is caused to some extent by the exigencies of the mills employing the water power. Thus attempts at controlling the river involve vested rights, and hence necessitate either agreement with the mills, or new legislation. Still, without this the condition of the river could be much improved. Noyes and Buss, speaking of the question of proper drainage, say:¹ "The problem is practically solved when the surfaces that are exposed by the rise and fall of the river have reasonably sharp slopes, and [are] free from any considerable decaying matter." Again:² "There are a number of sections which are nearly land-locked, and can be diked off at reasonable expense, thus maintaining the water surface at such a height as will prevent the exposure of the bottom when the river falls much below the standard height. It is not advisable to close any section in this way unless provision can be made for artificial circulation and renewal of the water in the basin. . . . There is another class of areas requiring treatment, which cannot be diked off, and are still land-locked in such a way that the current of the river cannot be used for their improvement. Portions of these should be treated with a light fill, carrying the surface above the ordinary fluctuations of the river, and protected against rapid current by the planting of trees at the upper end of the construction of such embankment as may be desired. The material for this fill can be taken from

¹ Loc. cit., p. 17.

² Loc. cit., p. 19.

sections lying just below the standard surface, and deepening the water over them enough to improve the character of the area. This, however, should not be resorted to in any localities where any danger to the public health would be feared from the disturbing and exposing of the material. For these sections the work should be done entirely by filling, and filling will be the cheapest in many cases where the strip to be treated is narrow and the bed of the river fairly deep within a short distance of the shore. The sections that lie between high and low water marks, and are exposed to the force of the current during freshet times, can be improved in some cases by cutting off the bushes and grass for three or four years in succession, and allowing the current to scour off the surface material which has accumulated on account of the retarding of the current. This in some cases can be assisted by a light floating boom extending below the surface, and provided with wings which deflect the current towards the sections to be removed."

We have here in this report upon a plan for drainage the recommendations of an engineer for improving the bed of the Charles River. This forms, as has been said, one of the most difficult portions of the problem to treat. Although these recommendations were not made with a view especially to the reduction of intermittent fever, yet the matters to which attention is called are also those that favor the growth of the malaria parasite, and hence the methods of treatment advised are applicable in the present case.

To resume, briefly, if we wish to stamp out this disease, some such measures as these must be used:—

1. Marshes and low lands, which are flooded when the river is high and exposed to the sun and air with insufficient drainage when it falls again, should be properly drained into the river when this is practicable.

2. When these moist lands lie at too low a level for direct drainage into the river, they should be protected by dikes from being flooded at high water, and subjected to cultivation, in order to reduce the amount of moisture in the soil. In our climate, with its cold winters and sudden variations of temperature, it is impossible to use the eucalyptus for this purpose, and some other plants must be found.

3. In low-lying lands thus protected by dikes resort can be had to wind-mills or other methods of pumping, in order to maintain

the ground water at a depth below the surface which will permit of cultivation of the soil, in case plants are used which do not grow in very moist ground.

4. Certain of these low-lying lands might be permanently flooded by the construction of suitable dams. If this means is used, care must be taken that a sufficient depth of water can be maintained over the whole flooded area, so that hundreds of square feet of moist soil will not be exposed to the air and sun, should the level of the water fall a few inches.

5. Similar precautions for maintaining a sufficient depth of water should be taken with the small ponds which already exist. They should be filled up, and the filled land properly drained; or they should be deepened when too shallow, and a sufficient depth of water maintained over the whole area to avoid the exposure of large surfaces of bottom when the water falls. In many instances a combination of filling and deepening will be found to be the best method of treating a pond. Care should be taken that the banks are reasonably steep, and in some cases it might be advisable to pave the banks of these and other bodies of water with stones, where a sufficient amount of water cannot be maintained at all times.

6. The same precautions to prevent the exposure of large areas of bottom should be observed in all artificial bodies of water, such as those used for manufacturing purposes and those for the supply of towns and cities, of which a considerable number exist in the district under consideration.

7. When the conditions favoring the growth of the hæmatozoön exist in the Charles River bed itself, some of the methods of improvement already mentioned should be used.

By the systematic use of such measures of prevention as these, varied in different parts of the area to be treated according to the various conditions present, using of course in each individual case the method which would be of least expense, we may hope to see this endemic disease finally and completely banished from the valley of the Charles River.

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